

Comparative Evaluation of Acupressure, Aromatherapy, and Stress Ball Efficacy in Reduction of Anxiety Levels in Children during Prophylactic and Restorative Procedures

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Received on: 11 September 2024; Accepted on: 10 October 2024; Published on: 20 March 2025

ABSTRACT

Background: Dental anxiety among pediatric patients needs to be tackled efficiently. Various nonpharmacological interventions, though proven effective, cannot be generalized for all. The use of complementary and alternative medicine has surged globally and is effective in reducing anxiety associated with dental procedures.

Aim: This study aimed to compare the efficacy of acupressure, aromatherapy, and stress ball for reduction of dental anxiety in children during prophylactic and restorative procedures.

Settings and design: Randomized controlled clinical trial.

Materials and methods: The study comprised 160 children aged 8–12 years requiring scaling or restoration on the first visit. The children were randomly allocated to four groups: group I ($n = 40$)—control, group II ($n = 40$)—acupressure, group III ($n = 40$)—aromatherapy, and group IV ($n = 40$)—stress ball. For all the children, a self-report measure of anxiety [Modified Child Dental Anxiety Scale (MCDAS) and Chota Bheem–Chutki Scale (CBCS)], along with pulse rate, SpO₂, and respiratory rate, were recorded at three different time frames. The Frankl scale was used as the behavioral measure for all the children.

Statistical analysis used: Student's t -test and ANOVA test were used to analyze the data.

Results: Aromatherapy showed significant results in all the six parameters used. The MCDAS scores of groups II, III, and IV showed significant mean differences when compared to the control group ($p = 0.000$). In the Frankl behavior rating scale and SpO₂ readings, differences in the aromatherapy and acupressure groups were found statistically significant in comparison with other groups ($p = 0.000$ and 0.005). Aromatherapy was found statistically significant compared to other groups in parameters like the CBCS and pulse rate. All the three groups showed significant results in the respiratory rate interval.

Conclusion: Aromatherapy was highly effective in reducing anxiety compared to the acupressure and stress ball groups during prophylactic and restorative procedures in children.

Keywords: Acupressure, Aromatherapy, Behavior management, Dental anxiety, Frankl behavior rating scale, Pediatric dentistry.

International Journal of Clinical Pediatric Dentistry (2025): 10.5005/jp-journals-10005-3070

INTRODUCTION

Dental anxiety among pediatric patients is one of the frequently encountered challenges in dental practice. Nonpharmacological interventions intended to minimize the usage of medications can be a viable option in handling a child, but cannot be generalized for all situations.¹

Recently, the implementation of complementary medicine is gaining ground. Acupressure has proven to alleviate anxiety in patients prior to undergoing medical treatment. It provides a simplistic, inexpensive option for treating the patient.² Aromatherapy, a type of complementary medicine in which the volatile oils are utilized by inhalation and massage, is gaining attention in pedodontic practice.³ Stress balls are also being used as a cost-effective method of distraction to relieve stress and anxiety.⁴

Literary evidence depicts that at an individual level, these three techniques were efficient in reducing anxiety, but their comparative efficacy has not been evaluated yet.⁵ The current study aimed to evaluate the effectiveness of acupressure, aromatherapy, and stress ball therapy for the reduction of dental anxiety in children during prophylactic and restorative procedures.

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How to cite this article: Koyande AP, Pathivada L, Krishna KM, *et al.* Comparative Evaluation of Acupressure, Aromatherapy, and Stress Ball Efficacy in Reduction of Anxiety Levels in Children during Prophylactic and Restorative Procedures. *Int J Clin Pediatr Dent* 2025;18(2):210–214.

Source of support: Nil

Conflict of interest: None

MATERIALS AND METHODS

This randomized controlled clinical trial was based on a parallel, double-blinded design. Subjects included children who reported to the outpatient department of pediatric dentistry as part of a

routine examination. Approval was obtained from the Institutional Ethics Committee in conformance with the ethical measures of the Helsinki Declaration. The study design was in accordance with CONSORT guidelines for clinical trials. Before the start of the study, parental consent was obtained after explaining the background of the study and its protocol.

Cooperative patients who recorded at least a 12 score on the Modified Child Dental Anxiety Scale Faces version (MCDAS) and indicated either full mouth supragingival scaling or restoration of existing pit and fissure defects on the occlusal surfaces of posterior teeth with minimal involvement of dentin (site one, size one carious lesion, according to Mount and Hume's classification) were considered as study subjects. Children lacking cooperation, suffering from physical or mental health problems, and with a history of common cold or allergy were excluded.

Setting the power of study at 80%, the ideal study population size was calculated as 63. Keeping a contingency provision of 10% and rounding off to the nearest multiple of 4, the proposed sample size was arrived at as 68.⁵

The recruited children were split among four groups, each including 17 subjects, that is, group I (control), group II (acupressure), group III (aromatherapy), and group IV (stress ball) by randomization software. One examiner was blinded to the group allocation and was trained and calibrated prior to study commencement. Allocation concealment was conducted by the study coordinator, who was not involved in the examinations of subjects, with group codes being disclosed only after the statistical analysis was performed.

For all subjects, anxiety levels based on standard scales [MCDAS and Chota Bheem–Chutki Scale (CBCS)]^{6,7} along with pulse rate and SpO₂ (Dr Trust Junior Pulse Oximeter, Nureca Inc., USA) and respiratory rate were recorded at three different time frames: pretreatment (15 minutes before the start of the treatment), mid-treatment (either after scaling of one arch is complete or after cavity preparation), and posttreatment (5 minutes after the completion of the treatment).

Procedure

Group I

No interventions were performed on the children in group I (control), apart from evaluating the study parameters as described earlier.

Group II

For children in this group, acupressure beads (Acuzone Ear Vaccaria Seed, K.S. Choi Corp., Los Angeles, Calif., USA) were placed on predetermined points, pressed gently for 10 minutes, and subsequently allowed to remain in place. Acupoints taken were: (1) extra one point (Yin Tang point), which is situated in the center between the two eyebrows, and (2) Shen Men point,

situated on the apex of the triangular fossa of the ear. Once the acupressure beads were placed on the acupoints and passive hold was maintained over them for 10 minutes, the required treatment procedure (scaling or restoration) was carried out. After the completion of the procedure, the beads and the adhesive tape were gently removed.

Group III

For children in group III, the procedure was carried out in a closed room where a ceramic diffuser was placed with four drops of orange essential oil (Soulflower, PT Invent India Pvt. Ltd., India) dispensed in its upper compartment with a lighted candle below. The ceramic diffuser was kept near the patient's chair so that the patient could inhale the scent throughout the procedure. Once the procedure was completed, the dispenser was extinguished.

Group IV

A stress ball was the subject, and they were asked to squeeze the ball throughout the treatment procedure. The children were allowed to squeeze the ball with either hand, as per their preference.

The Frankl behavior rating scale was utilized for behavioral measurement in the subjects, including oral examination, radiography, treatment, and departure from the dental chair, which were recorded. The overall score in the three-time frames was obtained by summing the ratings for each.

Statistical Analysis

Descriptive statistics were initially conducted to analyze the data distribution. The means (to estimate central tendency) and standard deviations (to measure the variability) were calculated. The inferential statistical analysis for the comparison of tabulated data was done using the Student's *t*-test and ANOVA test. Data was analyzed in Statistical Package for the Social Sciences (SPSS) version 16.0.

RESULTS

Descriptive statistics of the treatment groups are depicted in Table 1. Comparisons of all interventions in different time intervals on the scale are depicted in Table 2. A significant mean difference was seen in the acupressure, aromatherapy, and stress ball therapy groups in comparison with the control group ($p = 0.000$) in MCDAS pretreatment scores. Mid-treatment MCDAS scores in the acupressure, aromatherapy, and stress ball therapy groups showed a significant difference, whereas acupressure and aromatherapy also showed a significant difference to each other ($p = 0.000$). Posttreatment, all the interventions showed statistically significant differences to each other ($p = 0.000$) except in the comparison of the stress ball to the aromatherapy group ($p = 1.000$).

Regarding the CBCS, only the aromatherapy group showed statistically significant results compared to other groups in mid-

Table 1: Descriptive statistics among all interventional groups

Variable	Group I (control) Mean \pm SD	Group II (acupressure) Mean \pm SD	Group III (aromatherapy) Mean \pm SD	Group IV (stress ball) Mean \pm SD	X ² value	p-value
Age	10.53 \pm 1.66	9.94 \pm 1.71	10.06 \pm 1.43	10.29 \pm 1.26	21.073	0.049
Gender						
Male	3 (10%)	7 (23.33%)	8 (26.66%)	12 (40.0%)	9.782	0.021
Female	14 (46.66%)	10 (33.33%)	9 (30.0%)	5 (16.66%)		

Table 2: Posttreatment comparisons of different parameters

Parameters		Group I	Group II	Group III	Group IV	p-value
MCDAS	Pre	26.35 ± 1.53	24.00 ± 1.65	23.71 ± 1.96	23.56 ± 2.06	0.000
	Mid	25.06 ± 2.19	18.88 ± 2.89	20.53 ± 1.73	20.24 ± 2.07	0.000
	Post	22.65 ± 1.27	13.06 ± 1.95	16.12 ± 1.61	16.12 ± 2.93	0.000
	p-value	0.000	0.000	0.000	0.000	
CBCS	Pre	2.00 ± 0.00	2.00 ± 0.00	2.00 ± 0.00	2.00 ± 0.00	1.000
	Mid	1.76 ± 0.43	1.59 ± 0.50	1.12 ± 0.33	1.29 ± 0.47	0.083
	Post	1.00 ± 0.00	1.00 ± 0.00	1.00 ± 0.00	1.00 ± 0.00	1.000
	p-value	0.000	0.000	0.000	0.000	
Pulse rate	Pre	89.94 ± 6.14	91.29 ± 8.32	94.41 ± 9.91	89.71 ± 7.33	0.556
	Mid	91.65 ± 5.86	88.53 ± 8.32	92.00 ± 9.42	87.47 ± 7.27	0.423
	Post	93.59 ± 5.23	85.06 ± 7.89	88.53 ± 8.15	84.82 ± 8.05	0.002
	p-value	0.192	0.005	0.018	0.180	
SpO ₂ reading	Pre	98.12 ± 0.48	98.12 ± 0.33	97.65 ± 0.60	98.35 ± 0.49	0.390
	Mid	98.18 ± 0.52	98.24 ± 0.37	98.24 ± 0.66	98.24 ± 0.56	0.758
	Post	98.29 ± 0.47	98.82 ± 0.39	99.00 ± 0.00	98.53 ± 0.52	0.088
	p-value	0.575	0.529	0.000	0.267	
Respiratory rate	Pre	22.06 ± 1.08	22.65 ± 1.45	22.29 ± 1.04	22.24 ± 0.75	0.438
	Mid	22.47 ± 1.12	21.24 ± 1.09	20.59 ± 0.93	20.94 ± 0.65	0.002
	Post	23.29 ± 0.92	20.35 ± 1.05	20.24 ± 0.43	20.53 ± 0.71	0.000
	p-value	0.004	0.000	0.000	0.098	
Frankl behavior rating	Pre	3.00 ± 0.00	3.00 ± 0.00	3.00 ± 0.00	3.00 ± 0.00	1.000
	Mid	3.00 ± 0.00	3.29 ± 0.47	3.12 ± 0.33	3.12 ± 0.33	0.306
	Post	3.00 ± 0.00	4.00 ± 0.00	3.71 ± 0.47	3.59 ± 0.50	0.006
	p-value	0.000	0.000	0.000	0.000	

treatment ($p = 0.000$). No difference was seen in any group at pre- and posttreatment intervals.

For the Frankl behavior rating scale, aromatherapy (group III) showed significant results in mid-treatment ($p = 0.012$) as well as posttreatment time intervals ($p = 0.000$), while group II (acupressure) was found statistically significant in the posttreatment time interval ($p = 0.005$).

For pulse rate, aromatherapy showed highly significant results when compared to other groups at the posttreatment interval.

For SpO₂ readings, the aromatherapy group showed significant results in the pretreatment ($p = 0.005$) as well as posttreatment intervals ($p = 0.000$), while acupressure showed significant results in the posttreatment interval only ($p = 0.005$).

For respiratory rate, all three groups showed statistically significant results in the mid- and posttreatment intervals.

Intergroup comparisons of MCDAS posttreatment scores for all the interventions showed statistically significant differences with each other, except in the comparison of the stress ball to the aromatherapy group. For the CBCS scale, only the aromatherapy group showed statistically significant results compared to other groups in mid-treatment, and no difference was seen in any group before and after treatment.

For pulse rate, the aromatherapy group depicted highly significant results compared to other groups at the posttreatment interval. For the SpO₂ readings, the aromatherapy and acupressure therapy groups showed significant results posttreatment.

No differences were seen in any group pertaining to respiratory rate at the pretreatment time interval. At mid- and posttreatment, the aromatherapy, acupressure, and stress ball groups showed statistically significant results. For the Frankl behavior rating scale,

only the aromatherapy group showed significant results at the mid-treatment time interval. At the posttreatment time interval, only the aromatherapy and acupressure groups showed statistically significant results compared to other groups.

DISCUSSION

Anxiety-prone children pose a significant challenge to the treating dentist. Attempts to treat such patients with conventional methods may culminate in undue stress for all stakeholders.⁸ To counter this issue, several nonpharmacological interventions have been recommended and employed over the years.⁹ In this aspect, alternative medicine has shown promise as a behavior modifier.¹⁰ Though, on an individual level, aromatherapy, acupressure, and stress balls have been found to be effective in reducing dental anxiety, there is no evidence in the literature comparing the efficacy of these three interventions on dental anxiety in children.

Dental anxiety can be considered an excessive and unreasonable negative emotional state observed in patients, particularly children. Often, it is used interchangeably with the term "dental fear." Dental anxiety has been linked to several uncooperative or troublesome behaviors, subsequently leading to extended treatment times, high costs, and a plethora of other difficulties experienced by the treating team.¹¹

Several methodologies exist to measure dental anxiety. The MCDAS and CBCS ratings were implemented as primary outcomes for the present study, whereas the pulse rate, respiratory rate, SpO₂ levels, along with Frankl's behavior ratings, were taken as the secondary outcomes for this study.

The intragroup comparison of all parameters in all three intervals of the aromatherapy group showed a significant decrease in MCDAS, CBCS, pulse rate, and respiratory rate scores in the pre-, mid-, and posttreatment time intervals. SpO₂ readings and Frankl behavior rating scores showed a statistically significant increase with the time interval. These findings are in agreement with the observations of earlier studies.^{12,8}

The impact of aroma on the olfactory senses cannot be underestimated. It can directly stimulate the olfactory bulb, which then sends signals to brain regions associated with emotion, memory, and behavior, like the amygdala and hippocampus, allowing smells to trigger strong emotional responses and memories. Aromatherapy involves the application of essential oils to create a psychological effect through the sense of smell. Essential oils have been used since ancient times for healing and rejuvenation. Although various essential oils are used in dentistry, orange essential oil is usually the most preferred.⁹

In contrast, a study concluded that orange essential oils do not have additional benefits in alleviating patient anxiety. The authors argued that the stimulating properties of the oils may enhance sensory awareness, thereby making the subject more sensitive to pain stimuli.¹⁰ Purohit et al., in their systematic review, concluded that aromatherapy was effective in reducing patient dental anxiety.¹³

Acupressure, similar to the traditional Chinese practice of acupuncture, is based on the principle of manipulating the flow of Qi (pronounced “chee,” meaning “life force, energy flow”) in different ways to induce a therapeutic effect. Unlike acupuncture, it doesn’t involve the use of needles and is hence appropriate for children. The pressure points selected were the extra one acupoint or the Yin Tang point (located midway between the eyebrows), believed to induce sedation and change the sympatho-parasympathetic nerve balance, and the Shen Men point, located at the summit of the triangular fossa of the ear, which induces relaxation.¹⁴ Acupressure can be administered either by direct finger pressure or using a bead/pellet over the targeted points. In the present study, acupressure beads were employed over the selected points for constant pressure application. This method has an advantage over direct finger pressure in children, as it is not technique sensitive.²

Intragroup comparison of all parameters in all three intervals of the acupressure group showed a significant decrease in MCDAS, CBCS, pulse rate, and respiratory rate scores in pre-, mid-, and posttreatment time intervals. Frankl behavior rating scores gradually increased with time intervals, which showed a statistically significant result, whereas SpO₂ reading scores showed no statistical difference in time intervals. Recent studies on the efficacy of acupressure in ameliorating dental anxiety in pediatric patients reported positive results.^{15,16}

The exact mechanism of action of acupressure is still a matter of debate. However, several theories have been postulated: low-frequency electrical stimulation of neural receptors resulting in endorphin release from the hypothalamus; release of neuropeptide-induced anti-inflammatory cytokines; alteration of brain neurotransmitters like serotonin; hormonal regulation; subduing the activation of the sympatho-adrenal system; and blockade of incoming stress signals in the central nervous system by neurotransmitters such as norepinephrine and gamma-aminobutyric acid.^{17–22}

Diversion is a commonly employed technique to decrease the perception of procedural pain. It works by shifting the child’s focus

to a more engaging task, thereby hindering his or her capacity to attend to painful stimuli. Stress ball therapy involves a soft rubber ball that can change shape or color when squeezed. It has been applied as an active distraction method in pediatric operative procedures such as phlebotomy and catheter insertion.²³

In the present study, the intragroup comparison of all parameters in all three intervals of the stress ball group showed a significant decrease in MCDAS and CBCS scores, and Frankl behavior rating scores were significantly increased in pre-, mid-, and posttreatment time intervals. Where pulse rate, SpO₂ reading, and respiratory rate scores showed no statistical difference in time intervals.

Shekhar et al. reported that active stress ball distraction during local anesthesia administration decreased dental anxiety, although mildly, as compared to behavior guidance without distraction.²⁴ Conversely, Torres-Gomez et al. concluded that the stress ball distraction technique did not result in any significant reduction in stress levels in subjects who were given local anesthesia. They claimed higher accuracy of their study based on the evaluation of galvanic skin response to objectively measure patient stress and anxiety, with subjects serving as their own control.⁴

In the present study, after evaluating all the parameters for all the interventions, we found that aromatherapy showed highly significant results in all parameters, in that it can be safely said that aromatherapy was highly effective as compared to the other methods.

CONCLUSION

In recent years, complementary and alternative medicine has surged globally. In the present study, it was found that aromatherapy, acupressure, and stress ball techniques were considerably effective in alleviating dental anxiety in children. Comparing the three techniques, it can be said that aromatherapy was more effective than acupressure and stress ball therapies and the better method for reducing anxiety in child patients during prophylactic and restorative procedures. The preference for the use of one of the interventions is completely the choice of the practitioner after weighing the merits and demerits of each intervention. More such future studies are needed on larger sample sizes and also during more invasive procedures to substantiate the findings of our study.

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